

(12)

**EUROPEAN PATENT APPLICATION**

(21) Application number: 88305113.8

(51) Int. Cl.<sup>4</sup>: **H 04 M 1/72**

(22) Date of filing: 03.06.88

(30) Priority: 03.06.87 JP 139455/87

(43) Date of publication of application:  
07.12.88 Bulletin 88/49

(84) Designated Contracting States: DE GB SE

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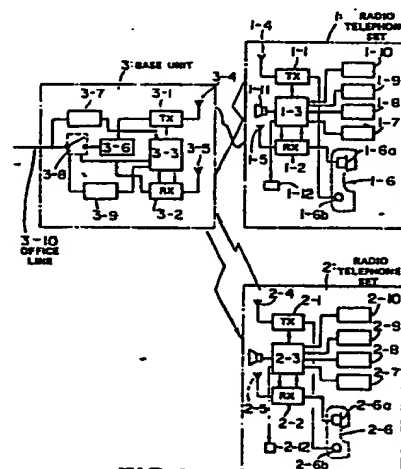
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(54) Cordless telephone apparatus and a method of controlling same.

(57) A base unit (3) delivers a ringing signal to a transferring radio telephone set (1) in telephone communication with an outside line and a receiving radio telephone set (2) in accordance with a request for transfer by the transferring radio telephone set (1). If the receiving radio telephone set (2) responds to the ringing signal and goes off-hook, the transfer operation to the receiving radio telephone set (2) ends. If the receiving radio telephone set (2) does not go off-hook, the transferring radio telephone set (1) responds to the ringing signal and goes off-hook to thereby retransfer the incoming call to the transferring radio telephone set (1).



**FIG. 1**

## Description

## CORDLESS TELEPHONE APPARATUS AND A METHOD OF CONTROLLING SAME

The present invention relates to cordless telephone apparatuses comprising a single base unit and a plurality of radio telephone sets which are coupled by a radio circuit and methods of controlling same and, more particularly, to apparatuses and methods of controlling same, which, in accordance with a request of transfer from a radio telephone set in conversation via an outside line, is adapted to transfer the telephone talk to another radio telephone set.

A cordless telephone apparatus is proposed which comprises a single base unit and a plurality of radio telephone sets connected via a radio circuit to the base unit and the base unit functions to switchingly connect a subscriber line, connected to the base unit, to any one of the radio telephone sets.

In the cordless telephone apparatus having such structure, when a radio telephone set in conversation with an outside line via the subscriber line transfers the telephone communication to another radio telephone set, the following structure could be conceived.

In order to keep the outside line DC (Direct Current) loop closed, the radio telephone set which transfers the telephone talk (hereinafter referred to as the transferring telephone set) first performs predetermined hold operations. Thus the base unit holds the outside line DC loop closed and sends a predetermined melody signal or the like indicative of that fact to the partner subscriber at the other end of the outside line.

Subsequently, the transferring telephone set dials the extension number of a radio telephone set to which the talk is to be transferred (hereinafter referred to as a receiving telephone set) and then goes on-hook to end the talk of the transferring telephone set with the partner subscriber.

When the base unit receives a signal indicative of the dial number of a receiving telephone set from the transferring telephone set, it establishes a radio circuit between the base unit and receiving telephone set and sends a ringing signal to the receiving telephone set.

A bell rings at the receiving telephone set in response to the ringing signal. When the receiving telephone set goes off-hook in response to the bell ringing, the base unit stops sending the ringing signal and establishes a communication channel between the receiving telephone set and the subscriber line. Thus the transfer ends and the receiving telephone set can talk with the partner subscriber at the other end of the outside line.

However, a person is not always at the receiving telephone set. It is assumed that the user at the telephone set transfers the telephone talk to the receiving telephone set without knowing that no one is at the receiving telephone set. In that case, no one responds to the ringing tone generated by the receiving telephone set due to the bell ringing signal from the base unit and the outside line partner is awaited held so long as the ringing tone continues to

ring. On the other hand, the operator at the transferring telephone set cannot at all know how the result of the transfer is because the transferring telephone set has already moved to its standby state. Therefore, there is the problem that each time transfer occurs, it is necessary to go and see whether anybody is at the receiving telephone set and whether normal transfer has been achieved.

If there is no one at the receiving telephone set even if a ringing tone is generated, there is the problem that the telephone talk cannot be retransferred to the transferring telephone set.

These problems derive from the use of only one pair of radio circuits. In order to solve these problems, an additional pair of transmitter and receiver and two radio circuits would be able to be provided. However, the cost would increase greatly and the size of the base unit would also increase undesirably.

It is an object of the present invention to a cordless telephone apparatus and a method of controlling same which eliminate the above problems, and are capable of ascertaining the transferred state and retransfer to the transferring telephone set.

In order to achieve the above object, the present invention provides a cordless telephone apparatus comprising: a base unit connected to a subscriber line; a plurality of radio telephone sets connectable via a radio circuit with the base unit; means for forming an outside line communication channel for any particular one of the telephone sets via the subscriber line by establishing a radio circuit between the base unit and the particular one of the radio telephone set; means for holding a telephone communication via the subscriber line in accordance with a request for hold from a transferring radio telephone set in telephone communication via the outside line and for generating a request for transfer to a receiving radio telephone set from the transferring telephone set to the base unit; means responsive to the request of transfer for establishing a radio circuit among the base unit set, and the transferring and receiving telephone sets and for delivering a ringing signal from the base unit to the receiving and transferring telephone sets; and means for releasing the hold of the telephone communication via the outside line, stopping the generation of the ringing signal, and forming an outside line communication channel via the subscriber line to the receiving telephone set when the receiving telephone set responds to the ringing signal, the releasing means releasing the hold of the telephone communication via the outside line, stopping the generation of the ringing signal and again forming the outside line communication channel via the subscriber line to the transferring telephone set when the transferring telephone set responds to the ringing signal.

The present invention provides a method of controlling a cordless telephone apparatus including a base unit connected to a subscriber line, a plurality

of radio telephone sets connectable to the base unit via a radio circuit, comprising the steps of: generating a request for holding an outside line through which a transferring radio telephone set of the radio telephone sets of the plurality is in telephone communication via the subscriber line, from the transferring radio telephone set to the base unit by operating the transferring radio telephone set and generating a request for transfer to the transferring radio telephone set from the transferring radio telephone set to the base unit; holding the outside line communication via the subscriber line at the base unit in response to the request for hold and generating a ringing signal from the base unit to the transferring and receiving radio telephone sets in response to the request for transfer; and releasing the hold of the telephone communication via the outside line, and forming an outside line communication channel via the subscriber line to the receiving telephone set when the receiving telephone set responds to the ringing signal; and releasing the hold of the telephone communication via the outside line, and again forming the outside line communication channel to the transferring telephone set when the transferring telephone set responds to the ringing signal.

According to the present invention, when the base unit calls the receiving telephone set, it also calls the transferring telephone set. Thus the user at the transferring telephone set can hear the ringing tone and notice that calling is being performed for transferring purposes. When the ringing tone does not stop for long, he also recognizes that no one is at the receiving telephone set. At that time, if the user at the transferring telephone responds using same, he can inform the outside line partner subscriber that nobody is at the receiving telephone set.

Fig. 1 is a block diagram showing a general structure of a cordless telephone apparatus according to one embodiment of the present invention.

Fig. 2 is a diagram of control sequence performed on the occurrence of a call from a radio telephone set in the embodiment.

Fig. 3 is a diagram of control sequence performed on the occurrence of an incoming call at the radio telephone set in the embodiment.

Fig. 4 is a diagram of control sequence involving hold and transfer in the embodiment.

Fig. 5 is a diagram of control sequence involving hold, transfer and retransfer in the embodiment.

In Fig. 1, reference numerals 1 and 2 denote radio telephone sets which include transmitters 1-1, 2-1; receivers 1-2, 2-2; control units 1-3, 2-3; transmission antennas 1-4, 2-4; reception antennas 1-5, 2-5; handsets 1-6, 2-6 including telephone receivers 1-6a, 2-6a and telephone transmitters 1-6b, 2-6b; hook switches 1-7, 2-7; dial keys 1-8, 2-8; hold keys 1-9, 2-9; extension keys 1-10, 2-10; and speakers 1-10, 2-10, respectively. Reference numeral 3 denotes a base unit which includes a transmitter 3-1, a receiver 3-2, a control unit 3-3, a transmission antenna 3-4, a reception antenna 3-5, a 2-wire to

4-wire converter 3-6, a ringing signal detector 3-7, a line relay 3-8, and a hold circuit 3-9. The converter 3-6 is connected via the line relay 3-8 to a main or office line 3-10.

The basic control operation of this embodiment will now be described with reference to the sequence diagram of Figs. 2 and 3.

(a). When a radio telephone set 1 issues a call

If the operator at the radio telephone set 1 causes the handset 1-6 to go off-hook in order to issue a call, the state of the hook switch 1-7 changes and this information is transmitted to the control unit 1-3. The control unit 1-3 drives the transmitter 1-1 and transmits a call signal including an identification code inherent to the radio telephone 1 via the antenna 1-4 using an electromagnetic wave in the control channel.

When the base unit 3 receives the identification code of the radio telephone set in the system via the antenna 3-5 and the receiver 3-2, it transmits a call-responsive signal including a channel designating code which designates an idle communication channel and an identification code, as the electromagnetic waves in the control channel via the transmitter 3-1 and antenna 3-4. When the radio telephone set 1 receives that electromagnetic waves via the antenna 1-5 and receiver 1-2, it selects and sets the designated communication channel. It further ascertains whether the selected channel is idle and transmits a channel selection end signal to the base unit.

The base unit 3 also ascertains whether its communication channel is idle. The radio telephone set 1 ascertains whether there is any fading occurring in the communication channel. If not, the radio telephone set transmits a fading detection end signal to the base unit 3. When the base unit 3 receives the fading detection end signal, it shifts to the next operation by determining that a radio circuit is established between the base unit and the telephone set 1.

The base unit closes its line relay 3-8, forms a closed direct-current loop with the exchange, simultaneously transmits a voice circuit on signal to the radio telephone set 1, and drives a voice circuit composed of the telephone transmitter 1-6a and receiver 1-6b in the handset 1-6 of the radio telephone set 1.

A dial tone signal delivered by the exchange via a closed direct-current loop including the office line 3-10 is modulated by the base unit 3 and output as a sound from the telephone receiver 1-6a in the handset 1-6 of the radio telephone set 1.

Then, by dialing a predetermined dial number at the radio telephone set 1 using dial keys 1-8, the dialed number signal is delivered to the exchange via the radio circuit and base unit. When the dial signal transmission ends, the exchange performs an exchanging operation and calls a desired partner subscriber. Thus if the partner responds, telephone communication is possible.

When the communication is to be ended, the handset 1-6 of the radio telephone set 1 is caused to go on-hook. The control unit 1-3 detects and

determines that the hook switch 1-7 has changed its state, and delivers an on-hook signal to the base unit 3. The control unit 1-3 delivers a talk end signal to the base unit 3 a predetermined time after the on-hook signal has been delivered. When the base unit 3 receives the talk end signal, it opens the the line relay 3-8 to thereby release the office line.

(b). When there is an incoming call from an outside line

When there is an incoming call at the system on standby from the office line, the ringing signal detector 3-7 of the base unit 3 detects a ringing signal delivered by the exchange, and transmits to the radio telephone sets 1 and/or 2 via the control channel an incoming call signal including the number of a communication channel detected as being idle and stored by the system on standby and the respective identification codes of the radio telephone sets.

When the radio telephone sets 1 and 2 receive that signal via the control channels, they select and set the designated channels of the receivers 1-2, 2-2 and checks to see if the designated channels are idle. If the channels are idle, the radio telephone sets 1, 2 send to the base unit 3 a "channel selecting end" signal. On the other hand, the base units 3 also selects and sets its designated communication channel and checks to see if the selected channel is idle. When the base unit receives a fading detection end signal from the telephone sets 1 and 2, it determines that a radio circuit is established, and sends out a bell ringing signal to the radio telephone sets 1 and/or 2 in order to deliver a ringing signal to the radio sets 1 and 2.

When the radio telephone sets 1, 2 receives the bell ringing signal, they generate a ringing tone from the speakers 1-11, 2-11 to thereby inform the users of the receipt of an incoming call from the office line.

When the user of the radio telephone set 1 responds to the ringing and causes the handset 1-6 to go on-hook, the hook switch 1-7 changes its state. The control unit 1-3 detects this change and transmits an off-hook signal to the base unit 3.

When the base unit 3 receives that off-hook signal, it closes the line relay 3-8 and forms a closed direct-current loop between the exchange and the base unit 3. At the same time, the base unit 3 delivers a voice circuit on signal to the radio telephone set 1. When the radio telephone set 1 receives the signal, it turns on a voice circuit including the telephone transmitter 1-6b and receiver 1-6a of the handset 1-6 to thereby enable conversation. The conversation ending operation is the same as that performed "when the radio telephone set 1 issues a call".

While the foregoing relates to the basic control operation of the system, the transfer control operation essential for the present invention will now be described with reference to the sequence diagrams of Figs. 4 and 5.

Fig. 4 involves the operation performed when the receiving telephone set 2 responds to the transfer of the incoming call, and Fig. 5 involves the operation performed when there is no operator available at the

receiving telephone set, the transferred call is not responded, and the operator at the transferring telephone set 1 has responded to the call.

Figs. 4 and 5 show the sequences after the telephone communication has been established because the function of transfer is used in that stage.

First, the control sequence of Fig. 4 will be described in detail. It is assumed that the radio telephone set 1 is in telephone conversation with the outside-line subscriber via the base unit 3. When the operator at the telephone set 1 transfers the outside line now under communication to the user at the telephone set 2, the user at the telephone set 1 presses the hold key 1-9 temporarily in order to keep closed the outside direct-current loop now under communication. In response to this, a hold signal is delivered from the radio telephone set 1 to the base unit 3 via the radio circuit. When the base unit 3 receives the hold signal, it turns on the hold circuit 3-9 in order to keep closed the outside line direct-current loop. At the time, a melody signal indicative of the establishment of the hold state is delivered to the partner subscriber at the other end of the office line. The user at the radio telephone set 1 presses the extension keys 1-10 to set an extension line and dials the extension numbers of the radio telephone set 2 to which the incoming call is to be transferred, and the handset is then caused to go on-hook to thereby result in communication end by the telephone set 1. On the other hand, the base unit 3 sequentially receives the dial signal, on-hook signal and talk end signal from the radio telephone set 1, stops the transmission of the electromagnetic waves via the communication channel used so far, and releases that channel.

The base unit 3 uses via the control channel an incoming call signal including the respective identification codes of the receiving and transferring telephone sets 2 and 1 and channel designating codes. When the radio telephone sets 1 and 2 receive that signal, they transmit an incoming call responsive signal to the base unit 3 and select and set the respective channels of the receivers 1-2 and 2-2 such that they can receive the designated communication channels. When the radio telephone sets 1 and 2 have completed the channel setting, they transmit a channel selecting end signal to the base unit 3. The radio telephone sets 1 and 2 ascertain that the designated communication channels are idle and transmit a fading detection end signal to the base unit 3 which then moves to the communication channel designated by itself and ascertains that that channel is idle, and forms radio channels for receiving the signals transmitted by the radio telephone sets 1 and 2 for transmission of any required matter.

The base unit 3 then delivers a bell ringing signal to the radio telephone sets 1 and 2. When the radio telephone sets 1 and 2 receives that bell ringing signal, they generate a ringing tone. The user at the radio telephone set 2 who has heard the ringing tone at that time would consider that he must respond because he is being called via the extension line while the user at the telephone set 1 would consider

that the ringing tone is one which calls the telephone set 2 due to his transfer operation.

When the user at the telephone set 2 responds by causing the handset to go off-hook, an off-hook signal is delivered from the radio telephone set 2 to the base unit 3. When the base unit 3 receives that off-hook signal, it stops the bell ringing signal generated so far, turns off the hold circuit 3-9, releases the held state of the office line kept so far, stops the transmission of the hold melody signal to the partner subscriber, and results in a communication enable state. When the radio telephone sets 1 and 2 stop the generation of the ringing tone by recognizing the stoppage of transmission of the bell ringing signal. The user at the radio telephone set 1 recognizes that the user at the radio telephone set 2 has responded, by the stoppage of the ringing tone from the radio telephone set 1, and also recognizes that the outside line is reliably transferred to the radio telephone set 2.

On the other hand, the radio telephone set 2 which has caused the handset to go off-hook receives a voice circuit on signal from the base unit to thereby enable communication with the partner subscriber at the other end of the outside line.

The ending of the talk is similar to that in Figs. 2 and 3.

Retransfer of the incoming call when no one is at the receiving telephone set will now be described with reference to Fig. 5.

Since the sequence in which after the transfer operation has been made at the radio telephone set 1, the base unit 3 calls the radio telephone sets 1 and 2 is the same as that in Fig. 4, further description thereon will be omitted. The user at the receiving telephone set 1 hears a ringing tone at the radio telephone set 1, knows that a call is being made for transferring purposes, but determines that the user at the radio telephone set 2 is absent because the ringing tone does not stop at all, and responds by taking up the handset 1-6 of the radio telephone set 1. By this off-hook operation, an off-hook signal is delivered from the radio telephone set 1 to the base unit 3. When the base unit 3 receives that signal, it stops the bell ringing signal, turns off the hold circuit 3-9, stops the transmission of the hold melody signal, and delivers a voice circuit on signal to the radio telephone set 1. By the stoppage of the bell ringing signal, the telephone set 1 stops the generation of the ringing tone, and turns on the voice communication circuit by reception of the voice circuit on signal.

Thus, since the outside line which is intended to be transferred to the radio telephone set 2 is retransferred to the radio telephone set 1, the system can inform the partner subscriber that the operator at the radio telephone set 2 is absent.

While in the above embodiment the transferring telephone set 1 is also constructed so as to generate a ringing tone as in the transferring telephone set 2, the transferring telephone set may be constructed so as to generate a ringing tone different in sounding aspects such as tone color and period from the receiving telephone set.

The transferring telephone set may be con-

structed so as to inform the user at the receiving telephone set that the incoming call is being transferred, by turning on and/or off the lamp 1-2 or 2-12 of Fig. 1 instead of the ringing tone being generated.

In that case, the base unit may deliver a ringing signal accompanied by a signal indicative of a receiving telephone set and/or a transferring telephone set. The transferring telephone set may store what it has transferred and may change the manner in which the transferring telephone set reports the incoming call; for example, by turning on and/or off a lamp, or ringing a bell, on the basis of the stored contents.

As just described above, the transferring telephone set is also called when the receiving telephone set is to be called, so that the user at the transferring telephone set can very easily ascertain the transferred state and can respond to the outside line by retransferring the incoming call to the transferring telephone set when the user at the receiving telephone is absent.

## Claims

1. A cordless telephone apparatus including a base unit connected to a subscriber line, a plurality of radio telephone sets connectable via a radio circuit with the base unit, and means for forming an outside line communication channel for any particular one of the telephone sets via the subscriber line by establishing a radio circuit between the base unit and the particular one of the radio telephone set, characterized in that there are provided:

means for holding a telephone communication via the subscriber line in accordance with a request for hold from a transferring radio telephone set in telephone communication via the outside line and for generating a request for transfer to a receiving radio telephone set from the transferring telephone set to the base unit;

means responsive to the request of transfer for establishing a radio circuit among the base unit set, and the transferring and receiving telephone sets and for delivering a ringing signal from the base unit to the receiving and transferring telephone sets; and

means for releasing the hold of the telephone communication via the outside line, stopping the generation of the ringing signal, and forming an outside line communication channel via the subscriber line to the receiving telephone set when the receiving telephone set responds to the ringing signal, the releasing means releasing the hold of the telephone communication via the outside line, stopping the generation of the ringing signal and again forming the outside line communication channel via the subscriber line to the transferring telephone set when the transferring telephone set responds to the ringing signal.

2. A cordless telephone apparatus according to claim 1, wherein the radio circuit includes a plurality of channels; and

the outside line communication channel forming means establishes a radio circuit between the base unit and a radio telephone set by selecting one of the plurality of channels.

3. A cordless telephone apparatus according to claim 1, wherein the radio circuit includes one control channel and a plurality of communication channels; and

the outside line communication channel forming means selects a radio telephone set for communication using the control channel, and connects the radio telephone set for the communication and the base unit through the selected communication channel;

4. A cordless telephone apparatus according to claim 1, wherein the outside line communication channel forming means forms a communication channel for a particular radio telephone set in response to an incoming call to the particular radio telephone set from the subscriber line.

5. A cordless telephone apparatus according to claim 1, wherein the outside communication channel forming means forms a communication channel for a radio telephone set which has issued a call, in accordance with the call from that radio telephone set.

6. A cordless telephone apparatus according to claim 1, wherein the radio telephone sets each includes a hold key; and

the transferring radio telephone set generates a request for hold by operating its key.

7. A cordless telephone apparatus according to claim 1, wherein the radio telephone sets each includes an extension key; and

the transferring radio telephone set generates a request for transfer to the receiving radio telephone set by inputting the dial number of the receiving radio telephone set.

8. A cordless telephone apparatus according to claim 2, wherein the ringing signal delivering means designates the transferring and receiving telephone sets using the control channel, and connects the base unit and the designated transferring and receiving radio telephone sets through the same communication channel and for generating a ringing tone signal through the same communication channel.

9. A cordless telephone apparatus according to claim 1, wherein the radio telephone sets each includes a ringing tone generating means; and

the transferring and receiving telephone sets are responsive to the ringing signal to cause the ringing tone generating means to produce a ringing tone.

10. A cordless telephone apparatus according to claim 1, wherein the ringing tone generated from the transferring telephone set is set so as to be different in tone color, timing and manner of generation from the receiving telephone set.

11. A cordless telephone apparatus according

to claim 1, wherein the radio telephone sets each include a ringing tone generating means and a display means;

the receiving telephone set is responsive to the ringing signal to cause the ringing tone generating means to generate a ringing tone; and

the transferring telephone set is responsive to the ringing signal to cause the display means to display that the incoming call is being transferred.

12. A method of controlling a cordless telephone apparatus including a base unit connected to a subscriber line, a plurality of radio telephone sets connectable to the base unit via a radio circuit, characterized by the steps of:

generating a request for holding an outside line through which a transferring radio telephone set of the radio telephone sets of the plurality is in telephone communication via the subscriber line, from the transferring radio telephone set to the base unit by operating the transferring radio telephone set and generating a request for transfer to the transferring radio telephone set from the transferring radio telephone set to the base unit;

holding the outside line communication via the subscriber line at the base unit in response to the request for hold and generating a ringing signal from the base unit to the transferring and receiving radio telephone sets in response to the request for transfer; and

releasing the hold of the telephone communication via the outside line, and forming an outside line communication channel via the subscriber line to the receiving telephone set when the receiving telephone set responds to the ringing signal; and releasing the hold of the telephone communication via the outside line, and again forming the outside line communication channel to the transferring telephone set when the transferring telephone set responds to the ringing signal.

13. A cordless telephone apparatus according to claim 12, wherein the radio telephone sets each includes a hold key; and

the transferring radio telephone set generates a request for hold by operating its key.

14. A cordless telephone apparatus according to claim 12, wherein the radio telephone sets each includes an extension key; and

the transferring radio telephone set generates a request for transfer to the receiving radio telephone set by inputting the dial number of the receiving radio telephone set.

15. A method of controlling a cordless telephone apparatus according to claim 12, wherein the base unit designates a transferring telephone set and a receiving telephone set using a control channel, connects the base unit and the designated transferring and receiving telephone sets through the same communication channel, and generating a ringing signal through the communication channel.

16. A method of controlling a cordless tele-

phone apparatus according to claim 12, wherein the transferring and receiving telephone sets respond to a ringing signal to generate a ringing tone.

17. A method of controlling a cordless telephone apparatus according to claim 12, wherein the ringing tone generated from the transferring telephone set is set so as to be different in tone color, timing and manner of generation from the receiving telephone set.

18. A method of controlling a cordless telephone apparatus according to claim 12, wherein the radio telephone sets each include a ringing tone generating means and a display means;

the receiving telephone set is responsive to the ringing signal to cause the ringing tone generating means to generate a ringing tone; and

the transferring telephone set is responsive to the ringing signal to cause the display means to display that the incoming call is being transferred.

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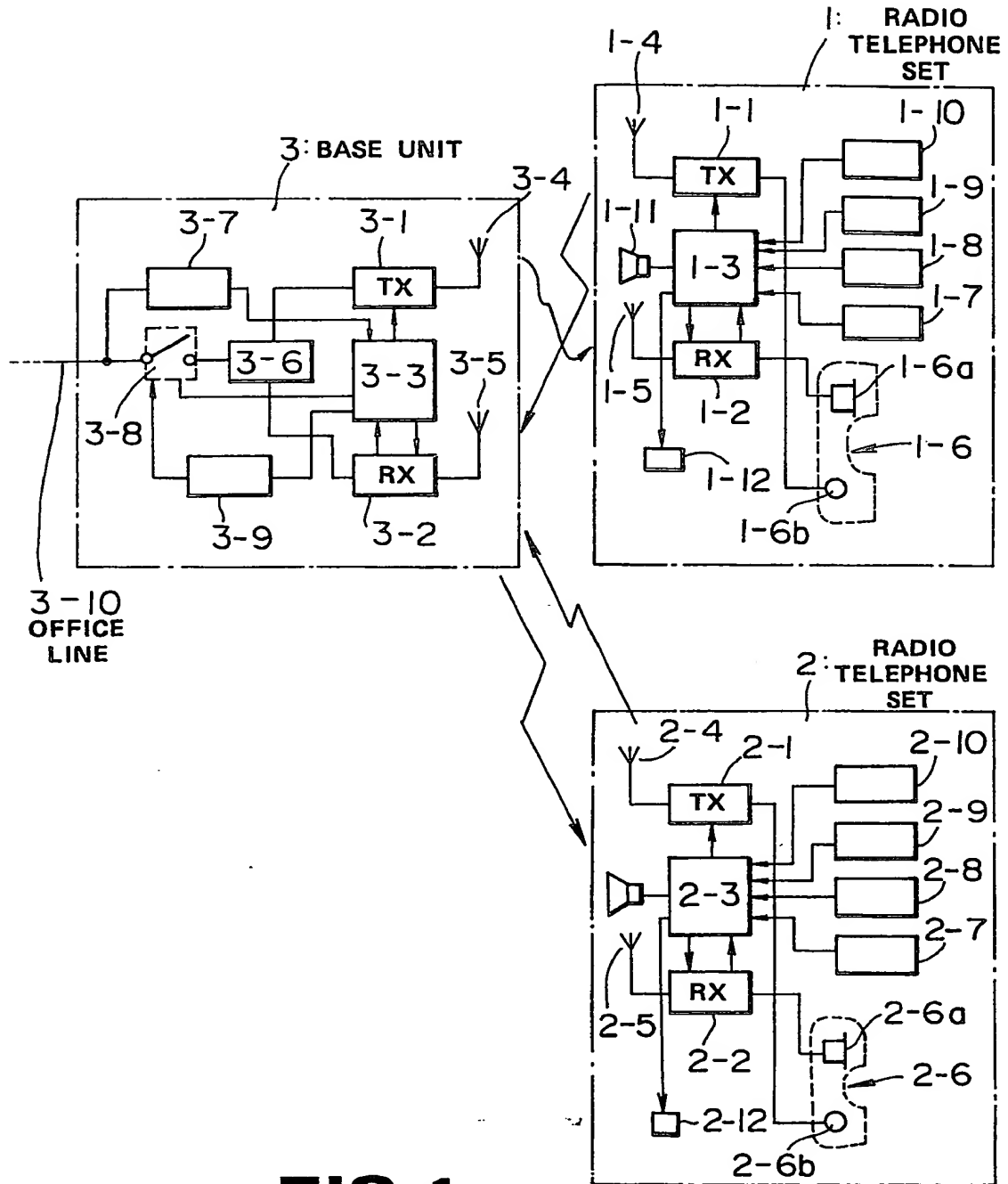
60

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15 00 00

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**FIG. 1**



15 08 88

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CALL FROM A RADIO TELEPHONE SET

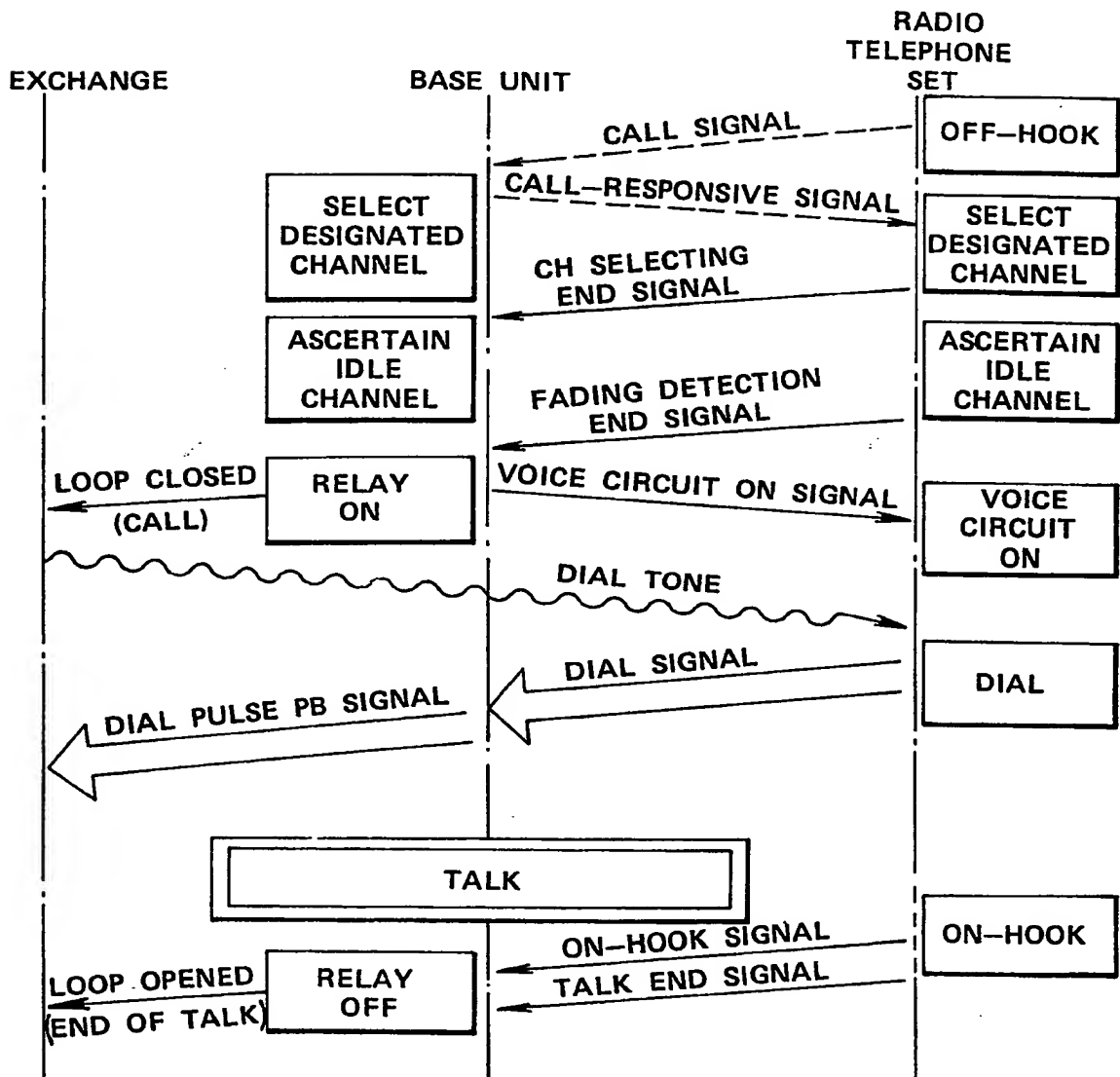
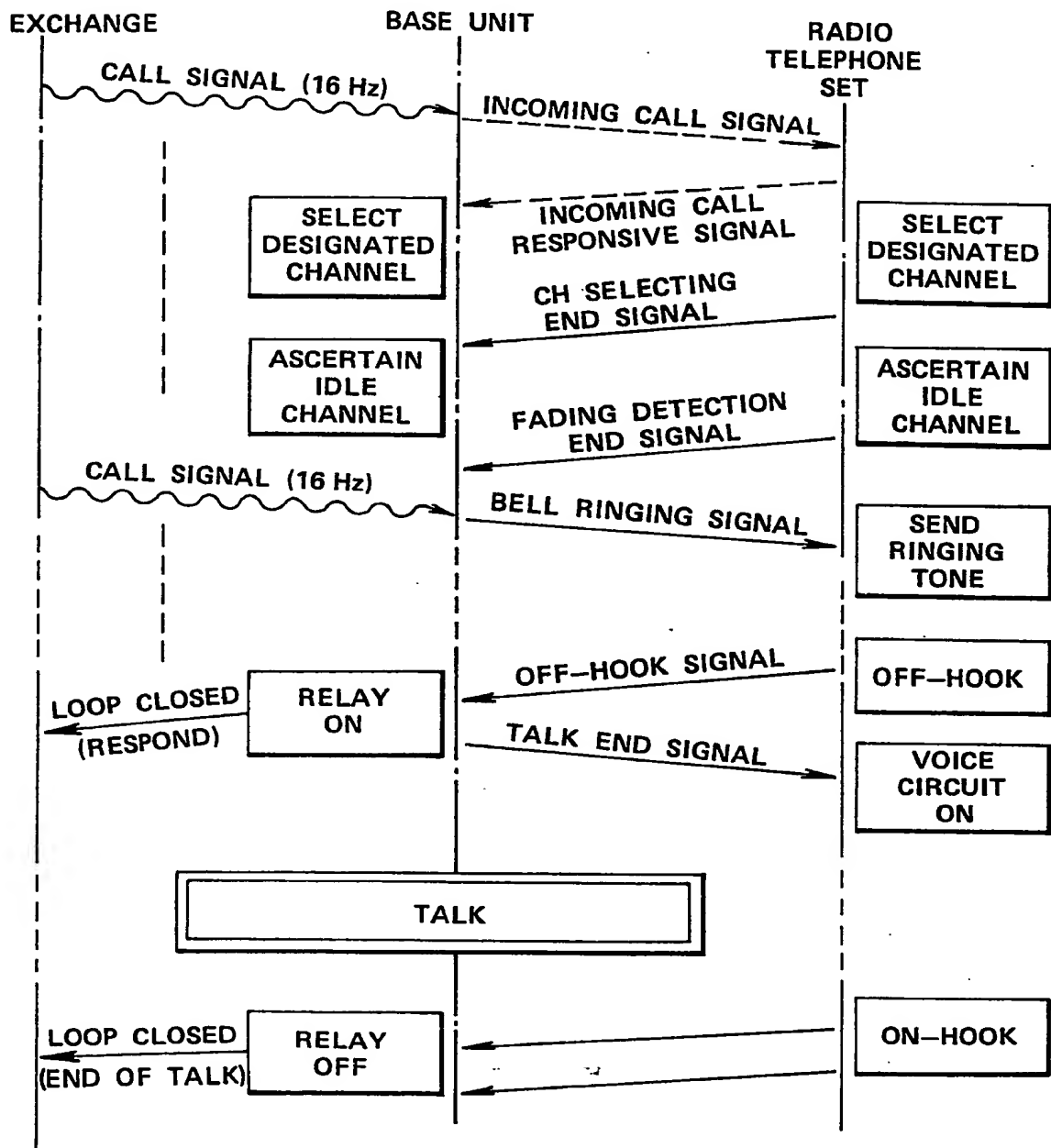


FIG.2

15 00 00

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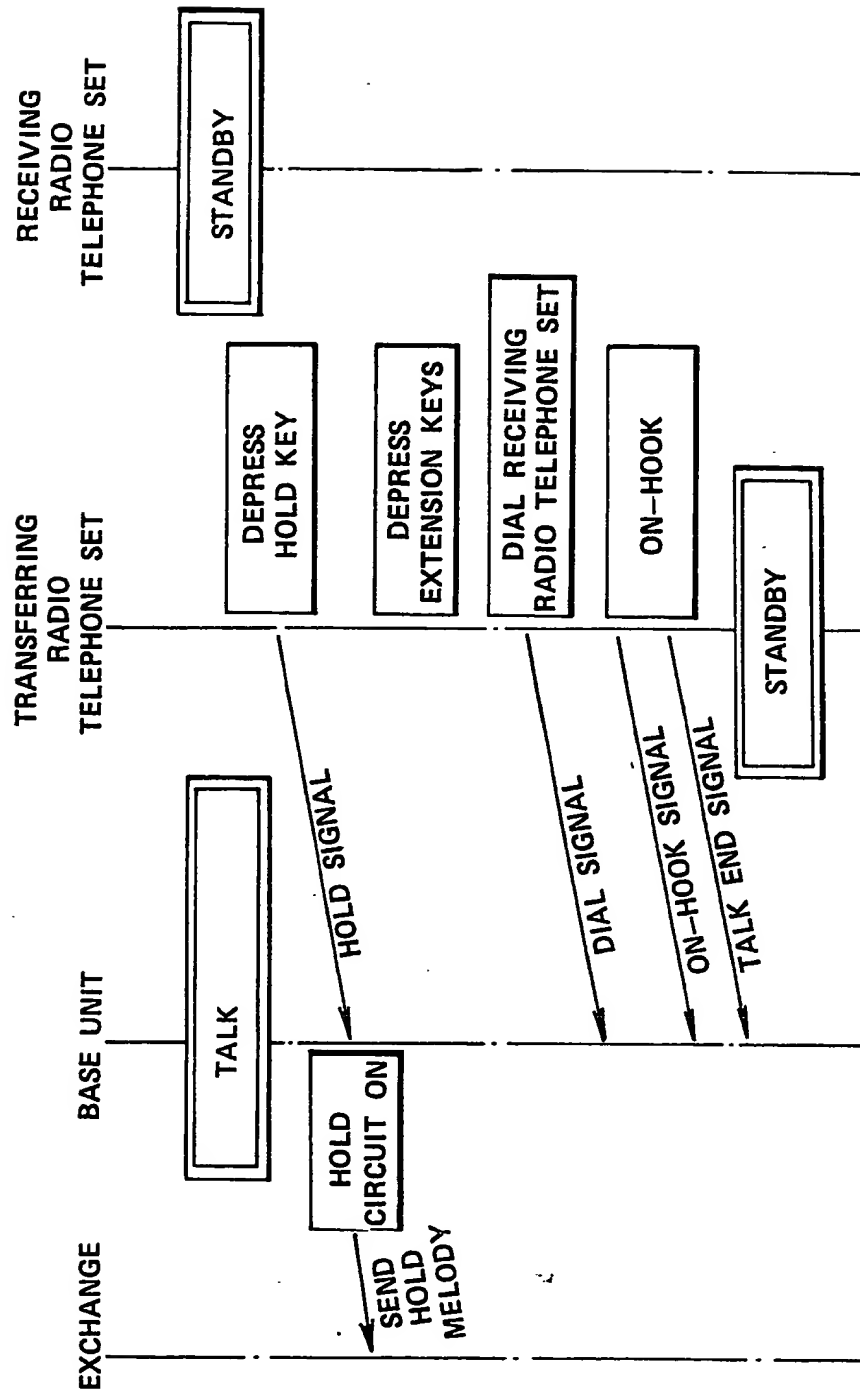
# INCOMING CALL TO A RADIO TELEPHONE SET



**FIG. 3**

15 08 00

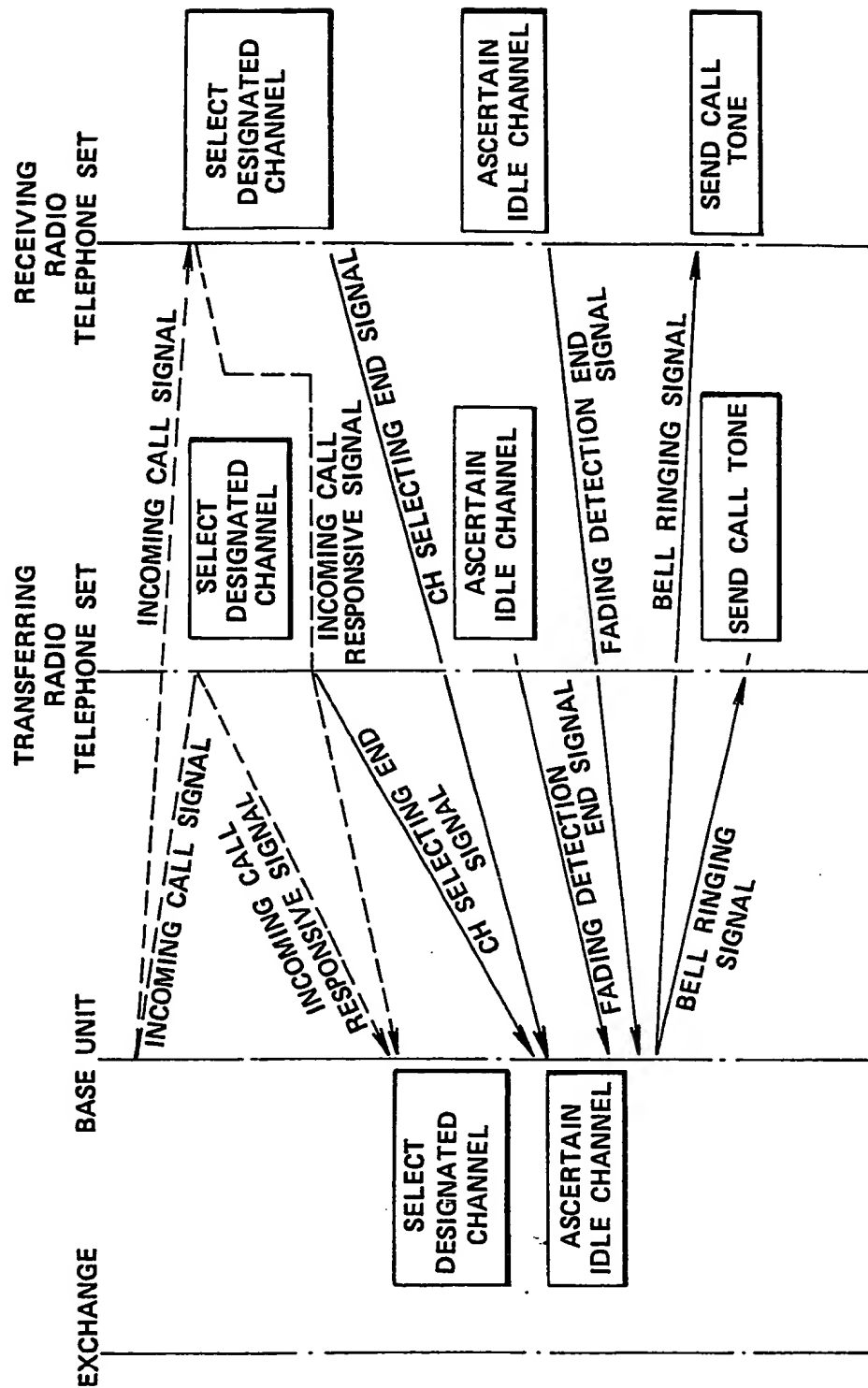
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**FIG. 4** Part I

19 08 08

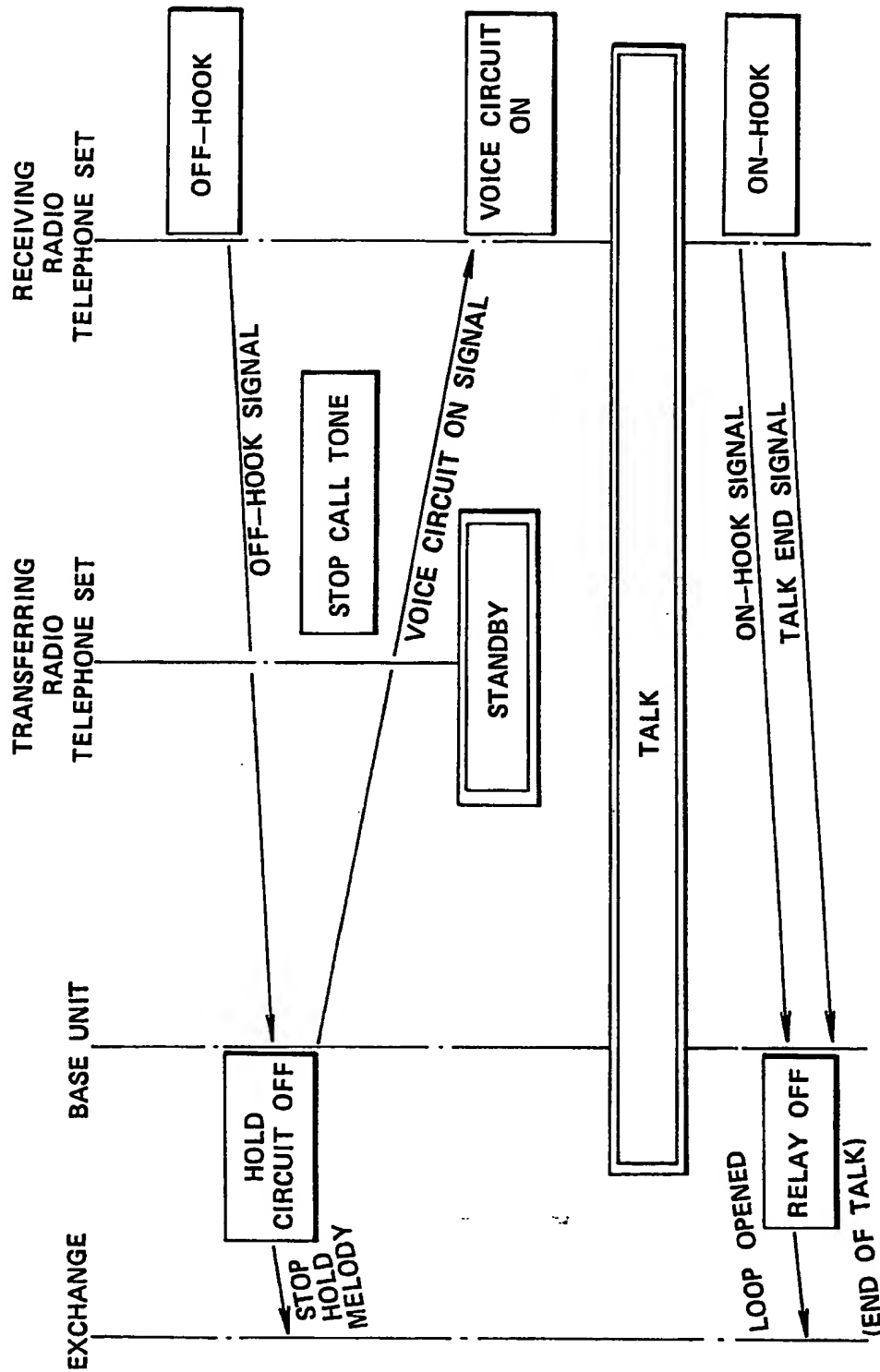
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**FIG. 4** Part 2

19 08 08

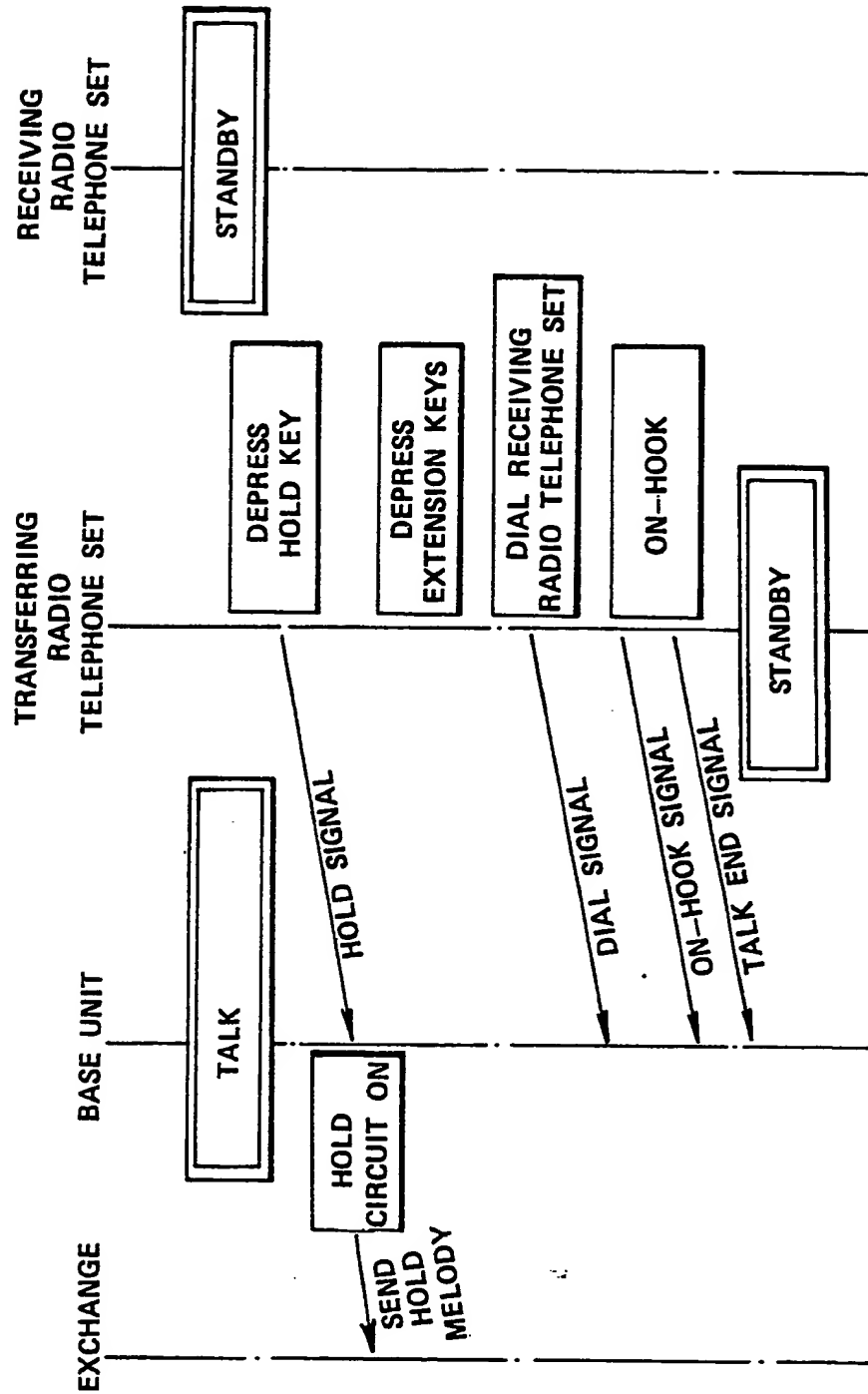
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**FIG. 4** Part 3

13 08 88

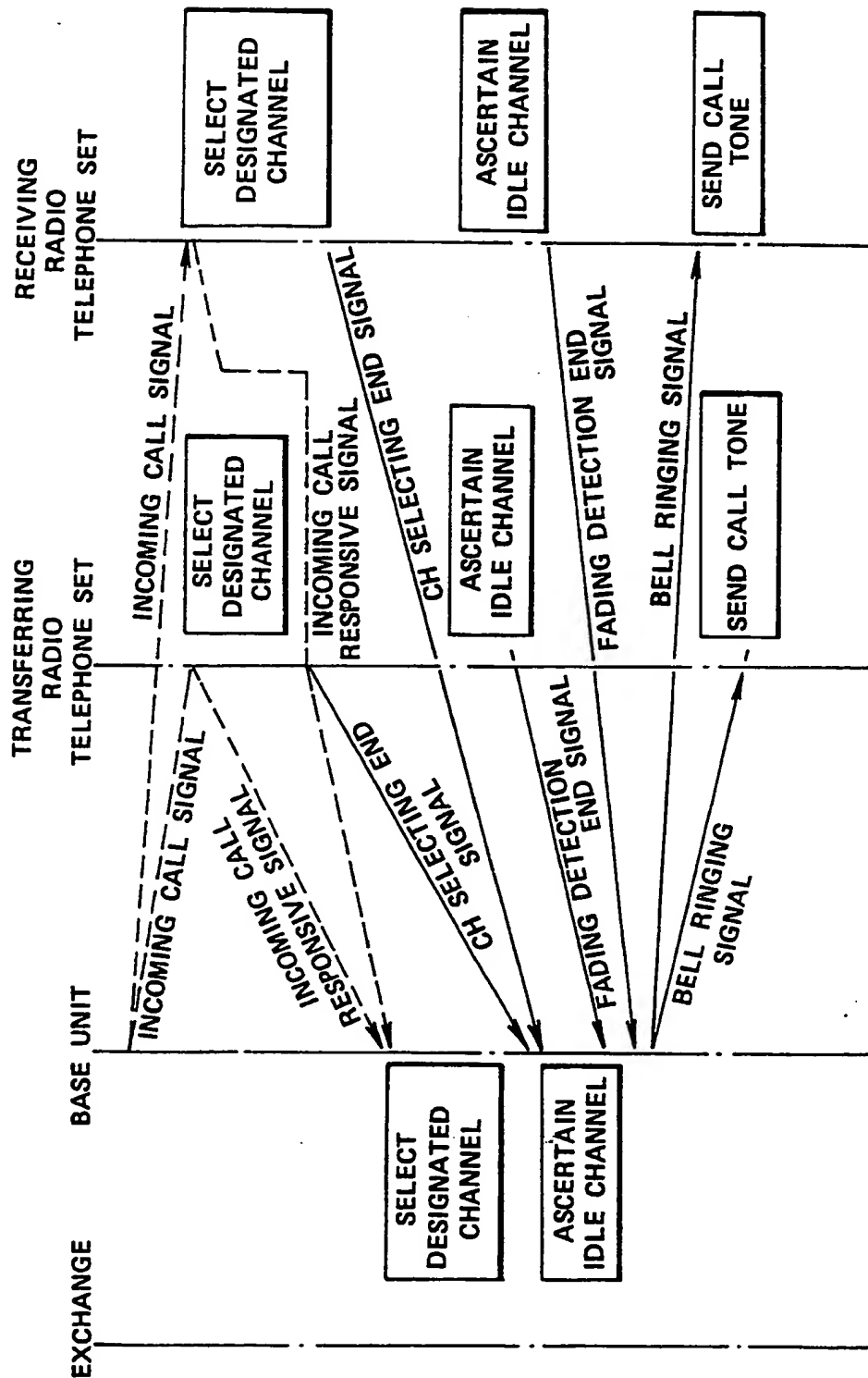
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**FIG.5** Part 1

15 08 88

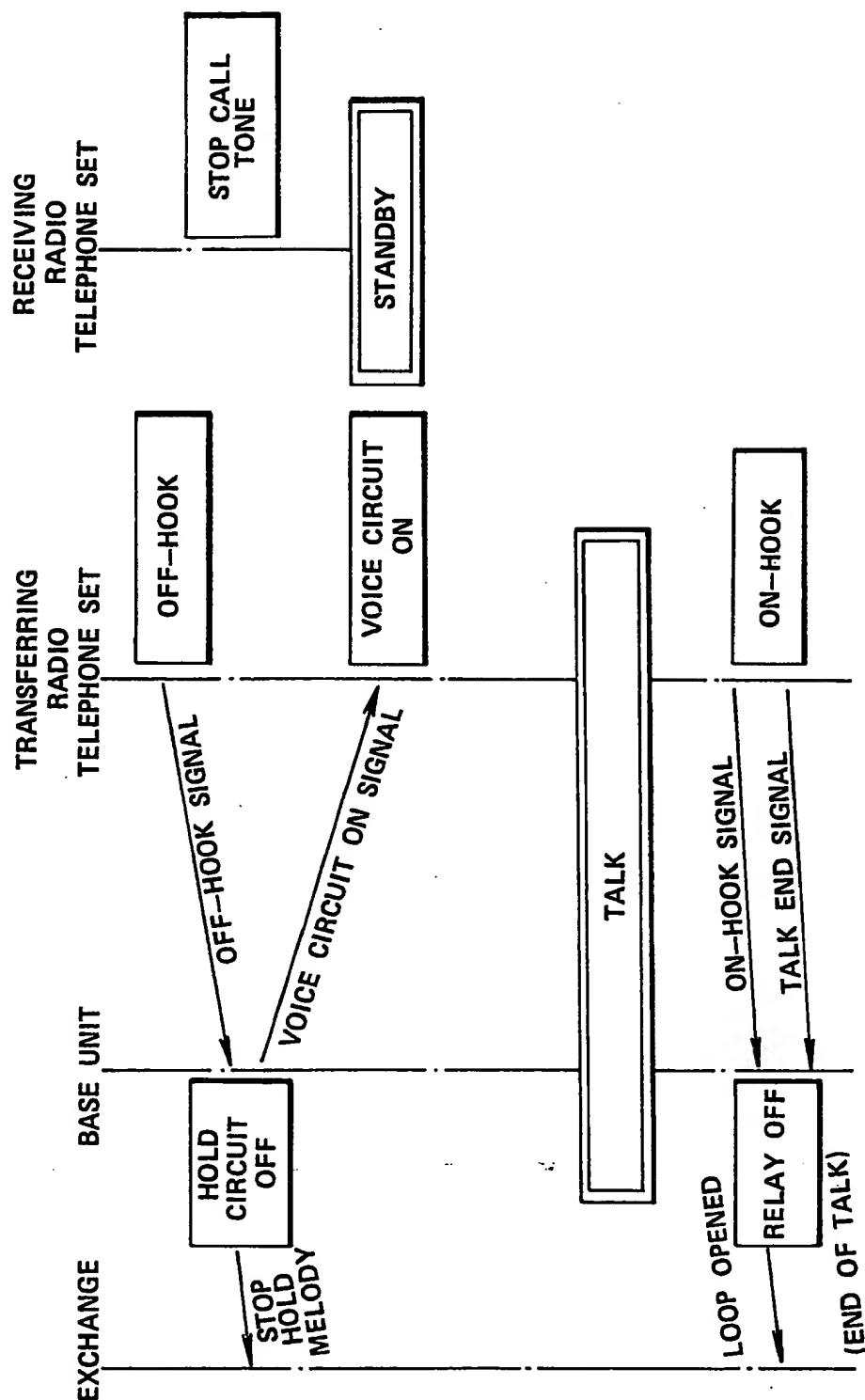
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**FIG. 5** Part 2

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**FIG. 5** Part 3